



Natural resource management is an evolving science. As park management needs change or come to light, so do the techniques used by resource managers to address them. New experiments are designed, research results are applied in new ways, and new technologies are developed to accomplish resource protection goals. Park and central office resource specialists are key to this process. During 1997, staff at Sequoia and Kings Canyon National Parks developed a GIS application that analyzes ecological needs and economic considerations to identify priority areas for prescribed burning. At Yellowstone, resource managers took steps to institutionalize greater protection of natural resources through new models for agreements with researchers who collect microbe samples from geothermal features. Also this year, the National Park Service developed a stronger presence on the World Wide Web, increasing the amount of technical information available about various natural resource programs and activities. Innovations such as these advance the state of resource management and provide building blocks for the next complex challenges.

First bioprospecting agreement targeted in Yellowstone

by Tami Blackford and Sue Consolo-Murphy

Units of the national park system are available for research that is compatible with resource preservation. Such research benefits park management by providing key information about park resources, processes, and visitors. Park-based research also contributes knowledge to the basic and applied research communities in the United States and around the world. Occasionally, the commercialization of products or processes derived from park-based research has returned profits to private industry. Until now, no administrative mechanism has existed by which parks could share in the financial benefits from research activities.

As global diversity declines, parks provide increasingly important repositories of unique resources for scientific studies and products that may benefit humankind. "Biotechnology," the practical application of biochemical processes, brings researchers to places like Yellowstone, where thermophiles (heat-loving microorganisms) have been found to contain heat-stable enzymes and other bioactive molecules. The first commercial application of these enzymes was in laundry detergent. Then major advances in molecular biology and genetic engineering brought another use. A technique invented in part by using a microbe collected in Yellowstone, *Thermus aquaticus*, makes DNA fingerprinting possible. Annual sales of this process now reach \$200 to \$500 million, which has led to even greater interest in Yellowstone's geothermal habitats. Of more than 50 microbiology projects currently permitted to collect samples, about half are sponsored by biotechnology companies or are academic research funded by the private sector.

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Researchers collect heat-loving microorganisms from a hot spring at Black Sand Basin during a 1995 research conference in Yellowstone National Park (Wyoming). An administrative mechanism was being developed during 1997 to allow the park to share in the financial benefits that can come from the commercialization of products or processes derived from park-based research.

In late 1997, Yellowstone National Park, the Natural Resource Directorate, and the Office of the Solicitor were working to complete a precedent-setting agreement that would close the loophole now allowing private entities to be the sole beneficiary of publicly owned resources. The agreement is expected to serve as a model that will benefit park resources, the companies involved, and the American public by returning a portion of profits from commercially valuable research to parks for conservation and related scientific and public education activities. The agreement will contain the same protections for park resources that govern all park research activities. Only collection of small quantities of research samples will be permitted, with a strict prohibition on "mining" the parks by returning repeatedly for new samples.

In August 1997, the Diversa Corporation of San Diego, California, signed a draft document, which when completed will be the first cooperative research and development agreement with the National Park Service. Under permit conditions, researchers may collect small samples of microorganisms and take them back to their

lab. The microbes themselves remain in federal ownership; they cannot be sold or given away. By law, an entire natural organism may not be patented. However, components of an organism discovered in the course of research, such as genetic code or novel enzymes, may become the intellectual property of the researcher. Under the terms of the draft agreement, if Diversa develops a profitable product from research based on Yellowstone microbes, the park is entitled to royalties. Whether or not the company makes a useful discovery, the company will supply money and services to advance Yellowstone's resource conservation program. Scientists estimate that less than one percent of the park's thermophiles have been identified to date. Without private research, much of Yellowstone's microbial diversity will remain unknown.

Dozens of parks may harbor commercially useful organisms in geothermal features, caves, springs, and even in ancient seeds left in the dwellings of prehistoric peoples. This new agreement attempts to provide a reasonable return to the public from park science while helping parks protect their unique resources in perpetuity.

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Safety

Safe conduct of bat surveys in abandoned underground mines

by John Burghardt

With the current national emphasis on abandoned mine reclamation, the National Park Service and other agencies have become increasingly concerned with assessing and preserving critical wildlife habitat that many mines provide. Most often this concern focuses on bats, which are becoming more dependent on abandoned mines for habitat as recreational caving and deforestation diminish their natural habitat.

External and internal surveys are both used to gain information on mine-dwelling bat species. External surveys can be conducted during seasons when bats are

active from dusk to dawn. However, internal surveys are the only way to obtain reliable data on hibernating bats, and they yield much more information on roost characteristics and bat behavior during active seasons. Winter underground surveys are most useful, as hibernating bats can be identified, and uneaten insect parts, guano, and urine-stained walls attest to spring, summer, and fall use. Ideally, surveys are conducted in all four seasons of the year before a mine is closed, as various species will use different portions of a mine for varying purposes through the course of a year.

Wildlife biologists conducting underground surveys are subject to the same hazards for which the mines are being closed. Oxygen-deficient air, toxic gases, unstable rock, vertical drop-offs, abandoned explosives, and hazardous waste are some of the hazards typically encountered. Abandoned underground mine specialists are therefore being linked with biologists to conduct underground habitat surveys. These specialists are equipped



Geologic Resources Division, Dave Sharov

Biologists may encounter "bad" air during underground surveys. Here, a specialist monitors for oxygen, carbon monoxide, methane, and alpha radiation.

to detect and experienced to deal with underground mine hazards, and they assume responsibility for the training and safety of inexperienced members of underground survey teams.

In 1997, several federal agencies collaborated to establish abandoned mine entry policies and safety training programs for employees who now find abandoned mine entry a routine part of their jobs. The NPS Geologic Resources Division is considering language for a policy, and has conducted numerous safety sessions with the general admonition to stay out of abandoned mines unless accompanied by a qualified safety specialist. The USDA Forest Service requires a qualified mineral examiner to lead abandoned underground mine research groups. With the assistance of NPS and BLM mining specialists, the Forest Service has developed a week-long mine safety course that has been attended not only by wildlife biologists, but also specialists in cultural resources, hazardous materials, law enforcement, search and rescue, and minerals management. The Bureau of Land Management is just developing an official policy, and is considering offering a



Geologic Resources Division

training course through their national training center. All three agencies are conferring on official criteria to certify individuals as “qualified” for leading underground surveys. These efforts will ensure that wildlife surveys and other important work in abandoned underground mines will be accomplished with maximum safety for all federal employees.

Mine safety specialists are now being linked with biologists to conduct underground wildlife surveys. Here, a specialist “bars down” a loose slab of rock at Lathrop Mine in Canyonlands National Park (Utah).

Resource Economics

Floccinaucinihilipilification or Pricing priceless mineral resources

by Phil Cloues

When mineral resources are vandalized or stolen, law enforcement professionals must determine a monetary value so that Department of Justice attorneys may seek punishment for the perpetrators. Floccinaucinihilipilification means the “estimation of something as valueless” and is often used as an argument by the defense counsel to reduce the charges for destruction of mineral resources such as cave speleothems like gypsum crystals, calcite stalactites, and stalagmites to a misdemeanor and small fine.

Park rangers, scientists, resource managers, cave specialists, attorneys, and mineral appraisers can team up in

an effective manner to bring about justice and send a message to potential vandals that the National Park Service takes its stewardship responsibility very seriously. By documenting an appraised value following government and private sector standards based on supply and demand economic market transactions, a real dollar value can be applied to a “priceless” natural resource. The use of a seasoned practitioner experienced in the field of mineral appraisal and tempered on the witness stand by the pounding of cross examination may result in a felony conviction that will serve as a deterrent to future acts of vandalism and theft. Managers can call upon the specialists of the Geologic Resources Division to give them court-supportable mineral appraisals or reviews of contracted third-party appraisal estimates of fair market value.

Two recent cases in which the Geologic Resources Division was involved may send this message. In May 1996, U.S. District Judge Thomas B. Russell sentenced

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Recognizing the interdisciplinary nature of solving natural resource crimes, the NPS Law Enforcement Program invited participation of natural resource and environmental protection specialists in an environmental crimes investigations course last September. Law enforcement and natural resource personnel learned options for jointly addressing park environmental crimes such as hazardous waste and ocean dumping, water pollution, pesticides violations, and environmental contamination of wildlife.



George R. Olson

Resource manager Rick Olson points to gypsum sheets destroyed by vandals in Crystal Cave at Mammoth Cave National Park (Kentucky). Park rangers, scientists, resource managers, cave specialists, attorneys, and a mineral appraiser recently teamed up to build a successful court case against the vandals.

three men to 21–33 months in federal prison for destruction of cave features in Crystal Cave at Mammoth Cave National Park (Kentucky). The judge said that the defendants had “stolen yesterday’s time,” destroying delicate crystal formations that took hundreds of years to form. Visitors will never again be able to view these wonders of nature. At the end of 1997, resolution is pending in another case on theft charges of selenite crystals by professional mineral dealers caught excavating specimens in Capitol Reef National Park (Utah). The value of the stolen crystals and damage to the earthen mound collection site, which contain highly sought-after clear “Utah Ice” crystals, is documented in a mineral appraisal that will be used in legal restitution of the case.

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Prioritizing fire planning needs through GIS

by Pat Lineback

Land and management agencies use fire for many reasons including fuel reduction for protection of human safety and to encourage natural ecological processes. Recently, the National Park Service and other federal agencies have begun to reemphasize the return of fire to the ecosystem. As land stewards with limited funding, parks need to carefully define and select the areas most in need of burning. During 1997, Sequoia and Kings Canyon National Parks (California) developed a process that integrated complex criteria to evaluate prescribed fire within a Geographic Information System (GIS) framework. Our goal was to identify high priority areas for future prescribed burning to optimize the use of funds and restore fire to those areas with the most ecological need.

Park staff developed models based on hazard, value, and risk criteria and integrated them within a GIS. The value model consisted of two parts: (1) ecological need and (2) infrastructure, human life, and safety. The ecological need component provided a rating index to rank areas on the need for fire. To gauge need, we considered

the historic cycles between fires (pre-1860) within major plant communities. The longer that the current time interval without a fire exceeded the maximum historic cycle, the greater the need. The analysis showed that Sequoia and Kings Canyon’s 30-year-old prescribed fire program has been insufficient in restoring fire to its pre-European frequency. For the infrastructure, human life, and safety component, we gave greater weight to areas of high visitation and those areas with buildings or other facilities.

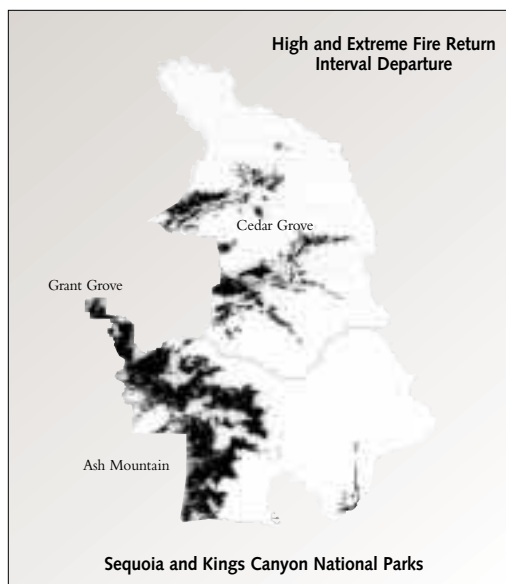
The hazard model considered key factors (fuel, slope, aspect, elevation) that affect human limits to control fire, or a fire’s resistance to control. Each factor was divided into three categories: high, moderate, or low hazard. Applying this model using GIS indicated that the largest portion of the parks was in the low hazard category and the smallest portion was in the high category.

Finally, for the risk model, we identified the risk of potential ignitions by examining the historic occurrence of both human and lightning-caused fires. We compared the number of fires as a ratio of fires per 1,000 acres for the 13 major watersheds within the two parks.

Although each model can be output as a separate analysis, we combined the models in various ways depending on the specific questions we were attempting to answer. Simple, color-coded park maps provided the

information for each fire analysis. The areas with the highest priority ratings based on value, hazard, or risk can be viewed in simulated 3-D when determining areas to focus planned ignitions. As these models evolve, improvements will include: better quality spatial and attribute data, incorporation of additional variables such as local topography, dynamic updating through further automation, and interagency cooperation and development of common analysis models that cross jurisdictional boundaries.

As severe wildfires increase in North America the use of fire for fuel reduction and ecosystem management will become more important. GIS will be an essential tool for planning and implementing such landscape-scale management programs.



The GIS application developed at Sequoia and Kings Canyon National Parks (California) can answer many important fire planning questions. This map shows where fire should be restored (dark area) based on greatest ecological need. Most of the areas are in the mixed-conifer forest and often coincide with heavily used areas of the parks.

Lake Mead “SWAT” team attacks tamarisk

by Curt Deuser, Jennifer Haley, and Ian Torrence

Lake Mead National Recreation Area’s newly established tamarisk control team is eliminating tamarisk from parks throughout the NPS Pacific West and Intermountain Regions. Funded through a Natural Resource Preservation Program (NRPP) grant, the team helps parks implement high-priority tamarisk control projects by providing expert staff and training. In 1997, the first season of operation, the crew of five traveled 6,497 miles and spent 2,005 hours removing tamarisk and other weeds from 160 acres at nine units of the national park system.

Tamarisk (*Tamarix ramossissima*), or salt-cedar, occupies approximately one million acres of public and private lands in the Southwest and threatens many park

ecosystems. Introduced into this country from Eurasia in the late 19th century, tamarisk escaped cultivation and invaded damp areas along riparian corridors that provide rare and important habitats in the arid West. Native plant species have difficulty germinating in dense tamarisk stands due to a lack of light and high soil surface salinity under the thick tamarisk leaf duff. Dense tamarisk stands preclude wildlife access, and the thirsty plant uses large amounts of water, sometimes drying up critical water sources.

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In its first year, the Lake Mead tamarisk crew traveled to nine parks, removing some 160 acres of the aggressive plant and other weeds. The team will continue its work for three more years.



Award Winner Profile

Superintendent honored for resource management

Winner of the 1996 Director's Award for Superintendent of the Year for Natural Resource Stewardship is Alan O'Neill of Lake Mead National Recreation Area, Nevada. O'Neill is a visionary who has built a professional resource management program at the Arizona-Nevada park. His commitment to resource protection is evident from his support of the park's burro management program, the razorback sucker recovery plan, and desert tortoise habitat protection endeavors. O'Neill also excels as a leader. He helped bring together numerous partners during the initial phases of the California Desert Ecosystem Management Initiative, a complex interagency framework for managing over 25 million acres of public lands. As chairman of the Pacific-West Region resource management and science task force, he leads by example, providing support to parks engaged in strategic planning efforts. His leadership has enhanced the NPS role in cooperative ecosystem management and sets an excellent example for all land managers.



Lake Mead National Recreation Area

Alan O'Neill, winner of the 1996 Director's Award for Superintendent of the Year for Natural Resource Stewardship.



(Both) Lake Mead National Recreation Area

Tamarisk removal is labor intensive, but can be effective in controlling isolated stands of the invasive species, such as this one along Sulphur Creek (above) at Capitol Reef National Park (Utah). To keep the area free of tamarisk (below), the park will need to treat the area periodically using techniques taught by the crew.

Over the years, many parks have struggled to control tamarisk, with varying degrees of success. Removal efforts are labor intensive and involve the use of chain saws, herbicides, and occasionally prescribed fire. Parks have had difficulty in gathering enough skilled and equipped crews to attack the plant. Additionally, standardized control methods needed to be developed to improve results and increase efficiency.

With the NRPP grant, Lake Mead NRA (Nevada and Arizona) developed protocols and trained staff to act as an expert "SWAT" team to help other parks deal effectively with their tamarisk problems. For each project in a park, the team involves local park staff, teaching them established control methods. Each park also

receives a tamarisk control manual developed by the crew. The crew then removes exotic plants from the park's highest priority area. In the first season, the average cost for tamarisk removal, including labor and herbicide, was \$687 per acre. The team has also controlled other nonnative plants that threaten riparian systems including Russian olive, ailanthus, Siberian elm, and ravenna grass.

The tamarisk removal crew, now increased to ten people, will continue to work in numerous parks for the next three years. Lake Mead staff and others believe this may be the best approach for managing weeds on a larger scale and will be looking for ways to continue funding for the team after the NRPP funding ends.



Education

Discovery station: Interpreting science for park visitors

by Neil Mackay

Scientific research is a vital, ongoing activity in the National Park Service. Unfortunately, many visitors are unaware of its importance in understanding and preserving parks. Traditionally, Harpers Ferry Center, the NPS interpretive design center, designs park exhibits to be “permanent.” But long-term exhibits are not always suited to interpreting natural resource issues where scientific research, inventory, and monitoring lead to continuing discoveries.

The situation is compounded by the difficulty of communicating science to visitors (especially younger visitors) in accurate, yet engaging, ways. Sharing scientific concepts frequently requires dynamic presentations, such as showing video footage or interacting with three-dimensional exhibits. Yet, typically these techniques have been limited to permanent exhibit installations. Clearly, parks need a new media approach to interpret current scientific research and natural resource issues effectively.

This challenge was explored in 1996 in a meeting of natural resource scientists and media specialists at Harpers Ferry Center. As a result, an interdisciplinary media team created the prototype for a new exhibit system called the “discovery station.” The station consists of standardized hardware that can be easily customized to accommodate several interpretive media, such as poster boards, television monitors, and interactive devices. This allows park staff to concentrate on developing the content for interpreting natural resource issues.

Big Thicket National Preserve (Texas) joined the team in 1997 to serve as the test site for a prototype station. Interpretive and resource staff chose “prescribed fire” as their first topic. Geared primarily for children, the media explain fire basics, describe vegetation types and the natural fire cycle, and explore how prescribed burning is a resource management tool. The station

presents profiles of David McHugh (Fire Management Officer at the park), Dr. Paul Harcombe (Professor at Rice University who has studied Big Thicket ecology for many years), and some of their colleagues. In this way, young visitors also see natural resource stewardship and science as interesting careers, an important message in its own right.

Big Thicket resource and interpretive staffs have already discussed future discovery station topics. These include: the preserve’s role as a global climate change monitoring site, an ongoing lepidoptera study, and the park program for the endangered Red-cockaded Woodpecker. To learn more about the discovery station, please visit the web site at www.nps.gov/discover.

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A newly designed “discovery station” allows parks to interpret science and resource management issues with great flexibility. The station accommodates bulletin boards, large-format graphics, scientific instruments, specimens, interactive devices, publication racks, and video and computer monitors.



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Conserving native wildlife in northeast Florida

by Daniel R. Tardona

Wildlife conservation has many faces, from zoos protecting animals in order that they may safely increase their numbers to national parks protecting wildlife habitat and animals in their natural surroundings. During 1997, the Timucuan Ecological and Historic Preserve and the Jacksonville Zoological Gardens developed an educational program aimed at conservation of the native wildlife of northeast Florida. The program educates the public on native wildlife issues and explains how these two different entities—national parks and zoos—both advance the goals of wildlife conservation. With this unique partnership, both groups hope to raise awareness of native wildlife issues and to generate a new understanding of the role of zoos and parks in wildlife conservation.

Zoological facilities, like the national parks, grapple with the challenge of providing a recreational environment while conducting ongoing research, resource management, and education that promotes wildlife conservation. A principle objective of the Association of Zoological Parks and Aquariums is to link zoos with in situ conservation.

This joint wildlife education program between

Timucuan and the Jacksonville Zoo provides the zoo with an opportunity to make such a link. For the park, this program provides a new and different kind of audience for the NPS conservation message.

When presentations are made at the zoo, the Timucuan Preserve can reach a more diverse ethnic and socioeconomic audience than normally visits national park sites. When presentations are made within the preserve, the audience typically is more conservative with regard to conservation and dubious of the zoo's commitment to wildlife conservation. Audiences in both locations are provoked to explore their preconceptions and expand their views about modern wildlife conservation.

This fast-paced program explains the necessity of conserving native species in northeast Florida and the roles played by the zoo, the park, and the public. Zoo animals are displayed, including federal and state listed endangered species as well as nonnative species. Program participants learn about the animals' habitat needs, behavior, and ecology, interspersed with information contrasting the differences and similarities of park and zoo contributions to wildlife conservation. Although systematic formal evaluation is needed, initial responses from the public at both sites have been extremely favorable.

Staff from the Jacksonville Zoo and Timucuan Ecological and Historic Preserve developed a novel education program during 1997. With presentations taking place at both the zoo and park, both organizations reached new audiences and explained their respective roles in native wildlife conservation.



Daniel R. Tardona

Park Operations

Information exchange fosters sustainability

by Judy Geniac

Throughout the national park system, employees are creating innovative ways to protect park resources. Paul Stoehr, Chief of Facility Management, improved the water quality at Everglades National Park (Florida) by switching to citrus-based cleaners, which break down quickly and do not add petroleum to the groundwater. In Organ Pipe Cactus National Monument (Arizona), Facility Manager Bill Mikus has been involved in replacing underground storage tanks with aboveground tanks. This approach allows employees to monitor the tanks for corrosion before any spills occur, avoiding disastrous and expensive damage to soil resources. Rick Olson, Ecologist of Mammoth Cave National Park (Kentucky), is currently working with park operations to replace most of the wooden boardwalk in the cave with plastic "wood." Real wood introduces a food source to the cave that supports introduced species, allowing them to out-compete the native cave species; if treated, wood can also leach copper, chromium, and arsenic into the water of the cave.

Like Paul and Bill and Rick, many other park employees find creative solutions to commonly occurring resource problems, often saving the park money with "green" products. Recognizing that these solutions should be acknowledged and shared, the Servicewide Maintenance Advisory Committee created the Environmental Leadership Subcommittee in 1996. The subcommittee is made up of park and central office staff.

In 1997, the subcommittee focused efforts on fostering communication between the Washington Office, service centers, regions, support offices, parks, industry, park contractors, and visitors. The newly reopened Green Alert electronic bulletin board encourages NPS employees to share their sustainability problems and solutions in an informal setting. A new web

site will focus on improved solid waste management techniques in parks, energy management, and other operational needs by linking to online government databases, full of product information. Parks will also post some of their success stories. The web site will be up and running in spring 1998.



The subcommittee is also helping parks by developing partnerships, providing information for the interpretation of recycling and other park operations, and creating signs. For example, the subcommittee has just launched a partnership called Partnership for Energy Conservation, which encourages universities to conduct park energy audits. The first audit, for Shenandoah National Park, was recently completed by the James Madison University Integrated Science and Technology Program. Alliance to Save Energy, a Washington, D.C., nonprofit group, secured a grant for the audit through the Department of Energy Federal Energy Management Program.

Working with the NPS Concessions Division, the Environmental Leadership Subcommittee is creating a course that will teach the concepts of sustainability and how they apply to the daily operations of park facilities. The subcommittee is also working closely with the NPS staff of the Hazardous Waste Management Program to increase awareness in the parks of hazardous substances and to minimize use of products containing such substances. The subcommittee's efforts during 1997 raised the awareness of sustainability and promoted practical, resource-friendly solutions in parks.

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This popular trail at Rainbow Bridge National Monument (Utah) has been stabilized with Road Oyle®, a nonpetroleum bonding emulsion that improves trail durability and reduces erosion. Environmentally appropriate solutions to park natural resource problems are being recognized and adopted more and more, in part because of the recent activities of the NPS Environmental Leadership Subcommittee.

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